INDOOR AIR QUALITY ASSESSMENT

Watertown Administration Building
149 Main Street
Watertown, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
December 2006

Background/Introduction

At the request of Steve Ward, Director of the Watertown Health Department (WHD), the Massachusetts Department of Public Health (MDPH), Center for Environmental Health conducted an indoor air quality assessment at the Watertown Administration Building (WAB), located at 149 Main Street, Watertown, Massachusetts. The request was prompted by concerns of mold growth on building materials, specifically on the surface of vents for the mechanical ventilation system, within the WAB.

On November 27, 2006, a visit to conduct an indoor air quality assessment was made to the WAB by Cory Holmes, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Mr. Holmes was accompanied by Nooshi Robertson, Purchasing Agent; Gerard Cody, Chief Environmental Health Officer and Mr. Ward during the assessment.

The WAB is a three-story red brick building constructed in the early 1930s. The basement of the WAB is occupied. Renovations that occurred in the mid-1990s included installation of heating, ventilation and air conditioning (HVAC) equipment, new windows, a dropped ceiling tile system, carpeting and other interior work. Windows are openable throughout the building.

Due to previous concerns of mold growth in the Council chamber room, Watertown officials hired Resource Laboratories, an environmental consultant, to conduct an IAQ assessment in September 2006. Resource Laboratories concluded that there were not elevated levels of airborne mold in the Council Chamber. However, heavy concentrations of mold spores were detected on and around ceiling-mounted supply vents in this area. Resource Laboratories recommended that a professional remediation firm be contacted to conduct remedial actions (Resource Laboratories, 2006). Watertown Officials hired Envirotech Clean Air, Inc., a professional remediation firm from Stoneham, Massachusetts, to conduct remediation activities in the Council Chamber.

Methods

CEH staff performed a visual inspection of building materials for water damage and/or microbial growth. Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor.

Results

The WAB has an employee population of approximately 50 and can be visited by up to 100 members of the public on a daily basis. The tests were taken under normal operating conditions. Results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in all areas, indicating adequate air exchange the day of the assessment. However it is important to note that the HVAC systems were not activated during the assessment, therefore no mechanical means of providing air exchange was being provided.

Heating and air-conditioning in common areas and interior spaces (e.g., meeting rooms, break room, mail room) is provided by air-handling units (AHUs) located in mechanical rooms. AHUs draw fresh outside air through air intakes located on the exterior of the building (Picture 1) and deliver the conditioned air via ducted ceiling diffusers (Pictures 2 and 3). Ceiling-mounted return vents draw air back to the AHUs through grated ceiling panels connected to ductwork. Ms. Robertson reported that a preventive maintenance program was in place for air-handling equipment.

Perimeter offices do not have mechanical means to introduce outside air but use openable windows in combination with fan coil units (FCUs) that recirculate air only (Figure 1). All FCUs were observed as deactivated during the assessment.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. In order to have proper ventilation with a mechanical ventilation system, the systems must be balanced subsequent to installation to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MPDH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix A.

Temperature readings the day of the assessment ranged from 71^{o} F to 74^{o} F, which were within the MDPH recommended comfort range in all areas surveyed. The MDPH recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Occupants reported difficulty maintaining temperature control in the lower hearing room.

Relative humidity measurements ranged from 34 to 38 percent, which were below or close to the lower end of the MDPH recommended comfort guidelines the day of the assessment. The MDPH recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. During winter months outdoor relative humidity levels tend to drop. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northern part of the United States.

Microbial/Moisture Concerns

During the assessment, visible mold growth was observed on the surface of metal ductwork and vents (Pictures 2 and 3). Metal is a non-porous surface constructed of materials that are not likely to be colonized by mold. However, these non-porous surfaces were coated with materials (e.g., dust) that can support microbial growth if exposed to moisture for extended periods of time. Regular cleaning of non-porous surfaces can remedy this type of mold contamination. In contrast, porous materials (e.g., boxes, books, insulation and ceiling tiles) should be removed/replaced to prevent further mold contamination problems.

Visible mold growth was also observed on pipe insulation above water-damaged ceiling tiles in the lower hearing room (Picture 4) and on pipe insulation in the basement air-handling room (behind the mail room/Picture 5). The pipe insulation appeared to be a fiberglass material, however due to the age of the building and the potential for asbestos containing materials to be present, it is recommended that the insulation be properly be identified by a licensed asbestos inspector prior to removal.

CEH staff observed a number of cardboard boxes and other porous items stored on the floor of the basement air-handling room (Picture 6). These items should be elevated (e.g., placed on pallets, tables) to prevent moisture/water damage and potential mold growth. Such materials would be particularly prone to support mold growth during periods of elevated relative humidity.

Repeated water damage to porous building materials (e.g., GW, ceiling tiles, carpet) can result in microbial growth. The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur.

Another potential source of mold growth and/or odors was observed on the exterior of the building in the form of accumulated leaves/plant debris in close proximity to fresh air intakes (Picture 1). A subterranean pit located along the front of the building is designed to allow air flow into the basement AHU. Over time leaves, trash, plant debris and other materials can accumulate in these pits. If materials in this pit become wet repeatedly, they can grow mold and provide a source of mold spores and odors, which can be drawn into the HVAC system via the intake vents.

Other IAQ Evaluations

Although a preventative maintenance program was reportedly in place for HVAC equipment at the WAB, CEH staff found accumulated dust and debris in the interiors of FCUs, which may indicate a lack of use and/or poor maintenance. In addition, the FCU in the lower hearing room was examined and found to have two small filters duct-taped together instead of one large filter. The type of filters installed provide minimal filtration of respirable dusts. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent (Minimum Efficiency Reporting Value equal to 9) would be sufficient to reduce many airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). Note that increasing filtration can reduce airflow, a condition known as pressure drop. A drop in pressure can subsequently reduce efficiency due to increased resistance. Prior to any increase of filtration, each FCU/AHU should be evaluated by a ventilation engineer to ascertain whether it can maintain function with more efficient filters.

Dirt/dust accumulation was observed around vents that had become dislodged from the wall in the main hallway (Pictures 7 and 8). The space between the vents and wall allows air to escape from the ductwork and draw air, dust and other particulates from the wall cavity resulting in staining around vents. In contrast, this phenomenon was not observed around vents that were flush with the wall.

Mr. Ward reported that occupants frequently commented on foul odors emanating from the handicapped restroom. The handicapped restroom does not have mechanical exhaust ventilation, but relies on an openable window to circulate air. However, the window is in disrepair and extremely difficult to operate. Exhaust ventilation is necessary in restrooms to remove moisture and to prevent restroom odors from penetrating into adjacent areas.

Finally, a gas-powered snow blower and gasoline container were being stored in the air-handling room (behind the mail room/Picture 9). Odors and off-gassing of volatile organic compounds (VOCs) from gasoline can be a source of respiratory irritation and have an adverse effect on indoor air quality. In addition the storage of these items indoors can pose a fire hazard.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Remediate mold growth observed on vents/ductwork in a manner consistent with recommendations in "Mold Remediation in Schools and Commercial Buildings" published by the US Environmental Protection Agency (US EPA, 2001). Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.
2. Due to the possible presence of asbestos in the building, the pipe insulation should be evaluated by a licensed asbestos inspector prior to removal/remediation. If deemed not to be a product with asbestos, then follow guidance in recommendation 1.
3. Clean supply and exhaust vents regularly of accumulated dust.
4. Seal around or make repairs to vents in main hallway (Pictures 7 and 8) to prevent escape/draw of air from wall cavities.
5. Replace any remaining water-stained ceiling tiles, GW and pipe insulation. Examine the areas above and around these areas for microbial growth. Inspect wallboard for water-damage and mold/mildew growth, repair/replace as necessary. Disinfect areas of microbial growth with an appropriate antimicrobial as needed.
6. Clean leaves and other debris from the exterior of fresh air intakes as needed to prevent the entrainment of mold spores/odors into the ventilation system.
7. Refrain from storing porous materials (e.g., cardboard boxes) directly on floor of air-handling room. Inspect and discard any water damaged cardboard boxes. Disinfect any

areas of microbial growth with a mild detergent; wipe surfaces clean with soap and water after disinfection.

8. Consider increasing the dust-spot efficiency of HVAC filters. Prior to any increase of filtration, each piece of air-handling equipment should be evaluated by a ventilation engineer as to whether it can maintain function with more efficient filters.
9. Consider balancing mechanical ventilation systems every 5 years, as recommended by ventilation industrial standards (SMACNA, 1994).
10. Change filters for air-handling equipment as per the manufacturer's instructions or more frequently if needed. Clean out interiors of FCUs and AHUs during each filter change. Ensure filters fit flush in their racks to prevent filter bypass.
11. Operate AHUs and FCUs in conjunction with openable windows to facilitate airflow.
12. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
13. Store gas-powered equipment and related equipment outside the building.
14. Install local exhaust ventilation to handicapped restroom to remove odors and moisture. Consider branching into existing exhaust vent for adjacent woman's restroom.

15. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. These materials are located on the MDPH's website at: http://mass.gov/dph/indoor_air.

References

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Picture 1

Fresh Air Intake for HVAC System

Picture 2

Supply Air Diffuser, Note Black Debris/Likely Mold Growth on Surface of Vent

Picture 3

Supply Air Diffuser, Note Black Debris/Likely Mold Growth on Surface of Vent

Picture 4

Visible Mold Growth on Pipe Insulation above Water Damaged Ceiling Tiles in Lower Hearing Room (Near Entrance)

Picture 5

Visible Mold Growth on Pipe Insulation in the Basement Air Handling Room (Behind the Mail Room)

Picture 6

Cardboard Boxes Stored on Floor of Basement Air Handling Room

Picture 7

Dust/Debris around Vents in Main Lobby Where Air is Escaping around Space between Vent and Wall

Picture 8

Dust/Debris around Vents in Main Lobby Where Air is Escaping around Space between Vent and Wall

Picture 9

Snowblower and Gasoline Can Stored in Air Handling Room (Behind Mail Room)

Location: Watertown Administration Building **Indoor Air Results**

Address: 149 Main Street, Watertown, MA **Date: 11/27/2006**

Table 1

Location	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (*ppm)	Occupants in Room	Windows Openable	Ventilation		Remarks
Background	375	60	39					Mostly sunny, scattered clouds, winds light & variable
Break Room	643	73	37	1	N	Y	Y	Mechanical ventilation-off, dust/debris, visible mold on metal surface of vents
Mail Room	665	72	37	1	N	Y	Y	Mechanical ventilation-off, dust/debris, visible mold on metal surface of vents
Basement Air Handling Room	629	72	38	0	N	Y	Y	Used for storage, visible mold on surface of pipe insulation, cardboard boxes on floor, gas can/snow blower
Main Hallway 1st Floor	727	72	36	0	N	Y	Y	Dirt/dust/debris deposits around vents, vents-not flush with wall-spaces
Health Department	733	72	34	1	Y	N	N	Vent/spaces between vent and wall
Handicapped Restroom	787	74	35	0	Y	N	N	No exhaust ventilation, window difficult to open
Women's Restroom	786	74	35	0	Y	N	Y	
Lower Hearing Room	512	71	35	0	Y	Y	Y	Visible mold on pipe insulation above water damaged ceiling tile

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%